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PM2.5 in the port city of Brindisi (IT): characterization, source assessment and dispersion modeling

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Abstract

In a sampling campaign, carried out from June to october 2012, in a port city of south Italy particulate matter (PM2.5) have collected. Chemical characterization of PM depositions for major ions, organic carbon, elemental carbon, metal content allowed identifying the major contributes to PM.

Introduction

The chemical characterization of atmospheric fine particles leads to important information on their sources. In fact, the approaches based on emission inventories and transport models are problematic in the evaluation of particulate atmospheric pollution because important sources are often fugitive. Moreover, there is an important contribution of secondary particles for the aerosol and the models used for the evaluation of gas-particle transformation are not very accurate. Instead, the study of PM concentrations at the receptor is essential to explain the relation existing between aerosol sources and processes related to their formation. This allows to improve scientific knowledge of atmospheric pollution processes and to evaluate the better control strategies which may contain toxicological outcomes of PM different sources.

Different approaches to receptor model analysis can be distinguished on basis of whether chemical characteristics of emission sources are required to be known before the source apportionment. On one hand, Chemical Mass Balance (CMB) requires the knowledge of the most relevant sources and their profiles impacting the sampling sites; on the other hand, multivariate receptor models as Factor Analysis (FA), Absolute Principal Component Scores (APCS) and Positive Matrix Factorization (PMF) require only ambient measurement data to perform source apportionment (Viana et al 2008). This last approach is very useful when information in sources composition is not easily available for the study area.

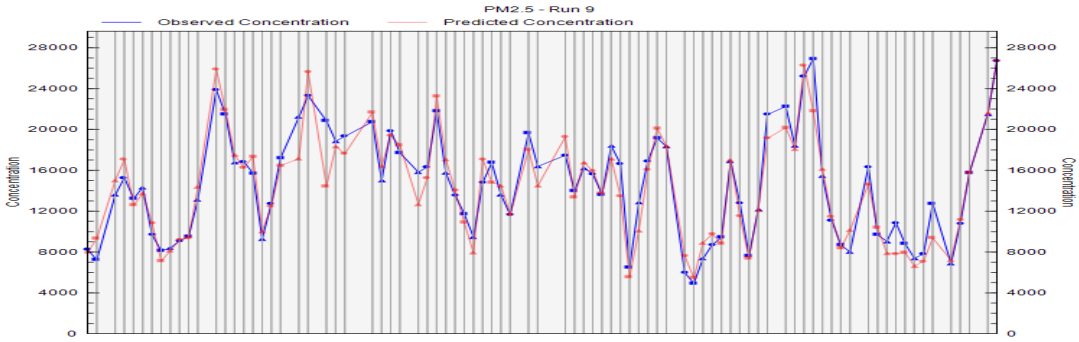
Materials & Methods

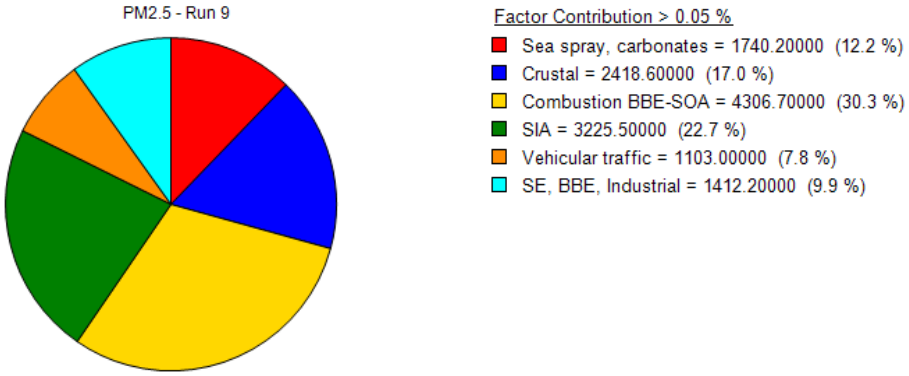
The sampling site was located in the Brindisi harbour-industrial area, located in the Apulia region (south-eastern part of Italy). Two sequential low-volume samplers (2.3 m3/h) were used to simultaneously collect PM2.5 samples. In total 100 samples were collected in the period between June and October 2012. Soluble ionic species (SO_4^{2-}, NO_3^-, NH_4^+, Cl^-, $C_2O_4^{2-}$, Na^+, K^+, Mg^{2+}, and, Ca^{2+}), metal, OC and EC content were analysed. Concentrations of the species were obtained with the removal of the average level present in the blank samples. The calculated concentration for a specific species is quantified if it is larger than the standard deviation σB of the blank filters, otherwise a threshold value equal to σB is considered. In cases in which the concentration was below the method detection limit (MDL), or not detectable above the average variability of the field blanks, a concentration value equal to the maximum between the MDL and σB was assumed. Statistical techniques, such as PCA (Principal Component Analysis), APCS (Absolute Principal Component

Scores), PMF (Positive Matrix Factorization), have been used in order to better characterize pollution sources. Large and local scale dispersion model have been run.

Results

Results from this sampling campaign seem to suggest that combustion (biomass, fossil fuel and heavy fuel oil), secondary aerosol, crustal matter resuspention and sea spray contribute to PM. It was reconstructed 99% of mass.





Large and local scale models showed that harbour and ships contribution to NO_x and SO_2 is larger with respect to the contribution to aerosol. Primary contribution to PM2.5 is relevant near the harbour area and it is quickly decreasing with distance but secondary contributions appears to interest a much larger area.

Conclusions

The main contribution to PM seems attributed combustion, secondary aerosol, crustal matter resuspention and sea spray.

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